

# Prevalence, control and risk factors associated with rabbit mange in Kiambu and Nyeri counties, Kenya

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## Abstract

The aim of the study was to determine the prevalence, risk factors and control strategies of rabbit mange in central Kenya. A cross sectional study using semi-structured questionnaires complimented with observational data sheets and sample collection was undertaken in June and July 2016. The overall mange prevalence was 57.3%. Inappropriate use of conventional and non-conventional treatment regimes by farmers, poor maintenance of hygiene in rabbit houses and sourcing of breeding stock from other farmers were identified as potential risk factors for rabbit mange infestation. The most common treatment options used by farmers against mange were ivermectin (25%) and sevin (16%). Mange is a major challenge in rabbit farming in Kenya, therefore, it is recommended that farmers and extension workers be informed on methods of its control. Additionally, further research is recommended to determine the efficacy of commonly used agents against rabbit mange in Kenya.

**Key words:** ear canker, ectoparasitism, liquid paraffin, mites, *Psoroptes cuniculi*

## Introduction

Rabbits are infested by various ectoparasites which include lice, ticks, fleas and mites. These are the most common causes of rabbit dermatoses (Sant and Rowland 2009). Of these, mites are the most important economically. They cause mange, a severe dermatitis which leads to economic losses and animal welfare problems in rabbit farms (Wall and Shearer 2001). From the literature, the most common mites infesting rabbits includes: *Psoroptes cuniculi* and *Cheyletiella parasitivorax*. *Sarcoptes scabiei* var. *cuniculi*, *Demodex cuniculi* and *Notoedres cati* var. *cuniculi* are rare (Sant and Rowland 2009). *Trombicula autumnalis* and *Dermanyssus gallinae* also infest rabbits (Van Praaq 2010). The most common rabbit mites in Kenya are *P. cuniculi* and *S. scabiei* var. *cuniculi* (Aleri et al 2012). Mange is highly contagious and can spread easily by direct contact between sick and healthy rabbits or indirectly through fomites (Sant and Rowland 2009; Panigrahi and Gupta 2013). Psoroptic mange (ear canker) is characterized by intense pruritus, head shaking, erythema and crusty lesions on the external ear canal and internal surface of the pinnae, ear drooping in extreme cases, foul smelling discharges in the external ear canal and pain on palpation of the ear (Wall and Shearer 2001; Swarnakar et al 2014). Sarcoptic mange is characterized by scratching, alopecia, crusts, scales and erythema on the skin. In chronic cases there is anorexia, lethargy, loss of body condition and death may occur (Wall and Shearer 2001). *Sarcoptes scabiei* var. *cuniculi* also causes transient itching dermatitis in humans (Hengge et al 2006).

In Kenya, mange is ranked the second most important disease affecting rabbits after diseases of the digestive (i.e., coccidiosis, mucoid enteropathy) system (Okumu et al 2015). Despite this, there are no adequate data on risk factors of rabbit mange and farmer practices that influence the occurrence of the disease and its management at farm level. Also, the safety and efficacy of available acaricides against rabbit mange is not known since they are registered and more widely used in other host species such as dogs and poultry and thus used as off-label products in rabbits. The present study documents farmer practices that influence risk factors and management of rabbit mange, and also identifies the most commonly used acaricides in control of mange in smallholder rabbit production systems in Kenya. The results will serve as a resource to support technical skills on rabbit mange control among animal health providers and farmers.

## Materials and methods

### Study area

The study was undertaken in Kiambu and Nyeri counties, Kenya. These counties have registered rabbit farming in central

Kenya (Serem et al 2013). Kiambu County is located between latitude 00° 25' and 1° 20' south and longitude 36° 31' and 37° 15' East. It receives an average rainfall of 1200 mm per annum and its temperatures range from 12 °C to 18 °C with a cold season from June to July. Nyeri County is situated between longitudes 36° 38' and 37° 20' E and between equator and latitude 00° 38'S. It receives rainfall amounts between 550 and 1500 mm per annum. Temperature ranges from 12 °C to 27 °C.

#### Study farms

These were selected randomly from the list of rabbit keepers maintained by the directorate of Livestock Production of both counties. Forty nine (49) and 48 farms were selected from Kiambu and Nyeri counties, respectively.

#### Study design

A cross sectional study involving farm visits where semi structured questionnaires were administered was undertaken in June and July 2016. Farm owners or rabbit attendants were interviewed and information entered into the questionnaire. Simultaneously, observational data (clinical status of rabbits and hygiene of their houses) was also obtained.

#### Clinical examination and sample collection

Ten percent (10%) of the rabbits were examined from farms with many rabbits but where they were few (< 10) all were examined for clinical signs of mange or presence of other ectoparasites. Samples (skin scrappings and ear scabs) were collected from rabbits with signs of scratching, alopecia, head shaking, crusty lesions on skin or ears and dandruff. Samples were labeled with farm number and rabbit identity from that farm and transported to the Parasitology laboratory in the Department of Veterinary Pathology, Microbiology and Parasitology, University of Nairobi for further processing.

#### Sample analysis

Samples collected were digested with 10% potassium hydroxide and observed under the microscope for identification and characterization of mites as described by OIE (2013).

#### Data analysis

Data was entered into Ms Excel and exported to SPSS statistical software for determination of descriptive statistics. Means and frequencies were used to identify risk factors and farmer practices associated with mange and analysis of variance was used to test significance of risk factors on prevalence of mange. Prevalence was defined as the proportion of rabbits in a population which were positive for mange mites on sampling (Margolis et al 1982).

## Results

#### Farmers' information

A total of 97 farms were visited in the two counties. Among the respondents, 80.6% were males and 19.4% were females. Most of the people responsible for making management decisions on farms were owners (54%) and their spouses (21.6%) and many of them had attained tertiary level of education (41.2%). Majority of rabbit farmers were over 50 years old (69.1%) while a few (1%) were between 21 and 30 years. Main occupations of rabbit farmers were farming (59.8%), business (19.6%), salaried employees (13.4%) and others (7.2%). Majority of them keep rabbits as a business enterprise (72.2%) and as a source of subsistence food (15.5%).

#### Clinical signs that farmers associated with rabbit ectoparasitism

Majority of farmers (79.4%) reported to have previously seen signs indicative of mange and other ectoparasites. Clinical signs that farmers observed included: scratching (39.9%), wounds (25.5%), crusts (21.1% and head tilting (13.5%) (Table 1).

**Table 1.** Clinical signs of ectoparasitism reported by farmers in different rabbit breeds

Breed	Frequencies of clinical signs observed by farmers						
	Scratching	Wounds	Crust	Head tilting	Parasites	Frequency (n)	Percentage (%)
New Zealand White	37	18	20	14	21	110	27
Cross	25	20	15	8	17	85	21
California White	23	13	14	9	12	71	17
Chinchilla	16	12	9	5	9	51	12
Dutch	9	9	5	4	4	31	7
Flemish Giant	12	5	3	1	3	24	6
French Earlop	6	3	3	1	2	15	4
Angora	4	4	2	2	1	13	3

**Clinical signs encountered during rabbit examination**

Sixty six percent (66%) of farms had clinical cases of mange with the following clinical signs: ear scabs (36.3%) (Figure 1), alopecia (24%), scratching (11.7%), crusts (8.8%), dandruff (1.8%), head tilting (1.8%) and skin wounds (0.6%).

**Figure 1.** A rabbit from a study farm in Kiambu County with ear scabs due to *P. cuniculi* infestation

**Prevalence of rabbit mange**

A total of 171 skin scrapings and ear scabs were processed for mites. *Psoroptes cuniculi* (Figure 2) was the only mite isolated from 49.5% of farms sampled. Based on the number of samples, the prevalence of this parasite was 57.3% (Table 2).

**Table 2.** Prevalence (%) of psoroptic mange infestation in Kiambu and Nyeri counties, Kenya

County	Number sampled (n)	Number infested (n)	Percentage infested (%)
Kiambu	101	42	41.6
Nyeri	70	56	80
Total	171	98	57.3

**Figure 2.** A male *P. cuniculi* isolated from skin scrapings of a rabbit from a study farm in Nyeri County, Kenya

**Predisposing factors**

The susceptibility of rabbit breeds to mange infestation is shown in Table 3. The most susceptible breed was the Flemish Giant (71.4%) relative to Checkered Giant which was the least susceptible (40%) (Table 3). There was no significant difference ( $p > 0.05$ ) in prevalence between males (60%) and females (61.2%) and with regard to age, prevalence was slightly higher in young rabbits (< 4 months) (62.5%) compared to adult rabbits (>4 months) (55.1%) ( $p > 0.05$ ).

**Table 3.** Percent (%) prevalence of mange in different rabbit breeds

Breed	Number sampled	Positive cases	Prevalence (%)
New Zealand White	53	32	60.4
Crosses	52	28	53.9
California White	18	11	61.1
Chinchilla	8	5	62.5
Flemish Giant	7	5	71.4
Checkered Giant	5	2	40
French Earlop	4	2	50
Angora	4	2	50
Dutch	3	2	66.7

Majority of farmers obtain their first stock (59.4%) and subsequent breeding stock (43.8%) from their neighbors. Farms that obtain their first stock from neighbors had a mange prevalence of 47.6% and almost the same prevalence (46.7%) in farms that source subsequent breeding stock from neighbors. Most farmers in this study borrow breeding bucks from their neighbors.

**Actions taken by farmers when rabbits are sick and source of information on drug usage**

Majority of farmers (42%) reported that they self-treat their rabbits when sick due to mange and other diseases (Figure 3) with most of them (40%) relying on their own experience and information from other farmers (21%) on drug usage. Others got information on drug usage from veterinarians (19%), agro-vets (11%) and only 10% followed manufacturer’s instructions.

**Figure 3.** Actions taken by farmers when rabbits are sick

**Treatment and prevention regimes used by farmers against mange and other ectoparasites of rabbits**

Farmers used both chemotherapeutic and non-chemotherapeutic agents to treat and prevent mange infestation. Common chemotherapeutics used were ivermectin (injection) (25%), sevin (16%) and tetracycline (14%). Non-chemotherapeutic agents like mineral oil, liquid paraffin, used engine oil and ash were also used by farmers to revert clinical signs associated with mange and other ectoparasites (Table 4). Most farmers (56.7%) apply treatment options only once.

**Table 4.** Frequency of various treatment regimes used by farmers to treat clinical signs associated with rabbit mange

Treatment regime	Clinical signs					Frequency (n)	Percentage (%)
	Scratching	Wounds	Head tilting	Parasites on the skin			
Ivermectin (injection)	12	3	0	2	17	25	
Sevin	1	0	1	9	11	16	
Tetracycline	8	2	0	0	10	14	
Mineral oil	4	1	1	2	8	12	
Liquid paraffin	3	1	0	4	8	12	
Multivitamin	3	1	2	0	6	9	
Ascarex	1	1	0	0	2	3	
Engine oil	2	0	0	0	2	3	
Ash	1	1	0	1	3	4	
Butasol	1	0	0	0	1	1	
Grabacin	0	1	0	0	1	1	

Majority of farmers reported that they apply various regimes for prevention either once (50%) or on a monthly basis (26%). A few farmers apply the regimes daily (5%), weekly (5%) and bi-weekly (8%).

#### Efficacies of various treatment and prevention regimes

Farmers who use mineral oil (100%), ivermectin (94%), liquid paraffin (85%) and sevin (81%) reported that these were efficacious against ectoparasites of rabbits (Table 5).

**Table 5.** Farmers' perspective on efficacy (%) of various treatment regimes on rabbit mange and other ectoparasites

Efficacy status	Treatment regimens				
	Sevin	Liquid paraffin	Mineral oils	Ivermectin	Rodent control
Efficacious	81	85	100	94	75
Not efficacious	3	6	0	0	12
Sometimes work	16	9	0	6	13
Total	100	100	100	100	100

Of farmers interviewed, 33% reported to control rabbit mange in their farms. Most of the farmers indicated that sevin, liquid paraffin and ivermectin were efficacious in prevention of clinical signs associated with rabbit mange (Table 6). Many farmers (88%) stated that rodents were carriers of mange mites and were convinced that their elimination was useful in control of rabbit mange.

**Table 6.** Farmers' perspective on efficacy (%) of various prevention regimes on rabbit mange and other ectoparasites

Efficacy status	Prevention regimens				
	Sevin	Liquid paraffin	Mineral oils	Ivermectin	Rodent control
Efficacious	93	82	0	100	88
Not efficacious	3	0	0	0	1
Sometimes work	4	18	0	0	11
Total	100	100	0	100	100

#### Hygiene of rabbit hutches

Over seventy percent (74.2%) of the farmers cleaned their rabbit hutches by changing beddings and only 10.3% used disinfectants while cleaning. Mange prevalence was highest (80%) in farms which washed their rabbit houses with water alone followed by those which did not do any washing, washed only when dirty or washed monthly (58.6%) ( $p < 0.05$ ). Prevalence was lowest (48.6%) in farms which change beddings only.

#### Discussion

Majority (80.6%) of rabbit farmers interviewed in the two counties were men. This skewed distribution was mainly because majority of households are headed by men who are also the registered land owners. Rabbit farming was practiced by farmers over 50 years old and this indicates that interest in rabbit farming among adults is on the rise. This is in agreement with observations of Hungu et al (2013) and Serem et al (2013) who attributed this to support of rabbit production by the government. Main occupation of the respondents was farming (59.8%) and they kept rabbits as a business enterprise rather than for subsistence. Similar findings were reported by Hungu et al (2013) and Serem et al (2013).

Majority of farmers reported to have previously seen signs indicative of ectoparasitism and our observation of 79.4% was slightly higher than 60.4% reported by Okumu et al (2015). The clinical signs farmers associated with ectoparasitism were observed in adult rabbits and New Zealand White breed which were predominant. Rabbits physically examined in 66% of the farms sampled had clinical signs of mange characterized by alopecia, scratching, crusts, dandruff, head tilting and skin wounds. These clinical findings were similar to those reported by other workers (Eshar 2010; Ayodha 2013; Swarnakar et al 2014; Okumu et al 2015).

*Psoroptes cuniculi* was the only mite recovered from samples collected with a prevalence of 57.3%. A previous study by Aleri et al (2012) revealed that the most common ectoparasites of rabbits in Kenya were *P. cuniculi* and *S. scabiei* var *cuniculi*. The reported prevalence was significantly ( $p < 0.05$ ) higher than that reported (16.4%) by Okumu et al (2015) but was lower than that reported (68%) by Gono et al (2013) in Zimbabwe. The high prevalence observed in the present study despite treatment and control of rabbit mange can be attributed to inappropriate usage of both conventional and non-conventional treatment regimes by farmers, sourcing of breeding stock from other farmers and poor maintenance of hygiene in rabbit houses.

Flemish Giant was the most susceptible breed with an infestation prevalence of 71.4% relative to Checkered Giant which was least susceptible (40%). This difference has been attributed to differences in resistance to parasitic infestations (Elshahawy et al 2016). There was no significant difference ( $p > 0.05$ ) in prevalence between males and females as reported by Souza et al (2008) and Elshahawy et al (2016).

Young rabbits (< 4 months) had a prevalence slightly higher (62.5%) than adults (55.1%) and this could be attributed to mixing of young and adult rabbits which was observed in some farms, thus getting infestation through direct contact. This was in agreement with observations by other workers on rabbit mange (Eshar 2010; Elshahawy et al 2016), small ruminants (Desie et al 2013) and dogs (Souza et al 2008).

Majority of farmers obtained their first and subsequent breeding stocks from their neighbors and this had an influence on mange prevalence in those farms (range 46.7 - 47.6%). Neighborhood sourcing of breeding stocks (i.e., burrowing of breeding bucks) encourages spread of mange because it is a highly contagious infestation that is spread by physical contact between sick and healthy animals (Hungu et al 2013; Panigrahi and Gupta 2013; Serem et al 2013).

Majority of farmers (42%) self-treated their rabbits when they suspected mange infestation and relied on their own experience and information from other farmers, veterinarians and agrovets on drug usage. Only a few (10%) followed manufacturer's instructions. Most farmers used treatment regimes that varied between farms and this may not be effective against mange. Additionally, frequency of application of these treatment regimes may vary from farmer to farmer as most of them applied treatment based on their own experience. This practice of self-treating rabbits by farmers is likely to lead to development of drug resistance (Currie et al 2004).

This study revealed that farmers use both chemotherapeutic (ivermectin, sevin, tetracycline) and non-chemotherapeutic (mineral oil, liquid paraffin, used engine oil, ash) agents to treat and prevent mange infestation. In Kenya, ivermectin is commonly used in management of rabbit mange (Aleri et al 2012) however, no study has been done to validate its efficacy and effectiveness. Most farmers (56.7%) used non-chemotherapeutic agents and these treatment options were applied only once. Studies done elsewhere also reported use of non-conventional methods including botanicals like garlic extract (Anthony et al 2005; Seddiek et al 2008) and plant essential oils (Traina et al 2005, Hanafi et al 2010) and other remedies like paraffin oil (Desoky 2015) to be effective against mange. Proverbs and Hutson (1992) reported that mineral or cooking oil put in the ear daily until mites are saturated was a highly effective method to cure ear canker of rabbits. In this study, farmers used sevin, liquid paraffin or ivermectin curatively or as preventive agents. These were efficacious against rabbit mange as was reported in other studies conducted in Kenya and elsewhere (Proverbs and Hutson 1992; Ulutas et al 2005; Kurtedede et al 2007; Aleri et al 2012). Eighty eight per cent (88%) of the farmers were convinced that elimination of rodents from rabbit hutches was useful in the control of rabbit mites.

Mites are not species specific but generally host specific. This means they will usually attack only a certain species host, but they will sometimes cross over from one species to another especially if their choice of host is not available (Wall and Shearer 2001). *Psoroptes cuniculi* has been found in domestic animals (goats, sheep, horses etc.) but do not affect humans (Harkness and Wagner 1995).

Mange prevalence was highest (80%) in farms which washed their rabbit houses with water alone followed by farms which did not do any washing, washed only when dirty or washed monthly (58.6%). Farms which changed beddings only had the lowest prevalence of 48.6%. Washing with water alone increases amount of moisture in rabbit houses and this together with low ambient temperatures have been attributed to high prevalence of mange in animals (Blood et al 2002). This study was conducted during the cold season (June and July) in the study area. However, observed poor management practices of rabbit houses by farmers may have contributed to the high prevalence of psoroptic mange recorded, as animals kept in poor environmental conditions are more susceptible to mite infestation (Souza et al 2008; Elshahawy et al 2016).

## Conclusions

- Rabbit psoroptic mange was highly prevalent in Kiambu and Nyeri counties, Kenya and this was associated with inappropriate use of both conventional and non-conventional treatment regimes by farmers, poor maintenance of hygiene in rabbit hutches and sourcing of starting and subsequent breeding stock from other farmers.
- Mineral oils, ivermectin, sevin, liquid paraffin and rodent elimination were reported by farmers to be effective in treatment and control of rabbit mange.
- Further research is recommended to determine the efficacy of common chemotherapeutic agents and preventive strategies of rabbit mange in Kenya and to validate farmers' perspective.

## Conflict of interest

The authors declare that there is no conflict of interest

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